



## ***Interactive comment on “***

# **Experimental validation of some basic assumptions used in physically based soil erosion models” by S. Wirtz et al.**

### **Anonymous Referee #3**

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#### General comments

The paper addresses an important issue: are deterministic methods adequate for soil erosion modeling? The authors' focus is on the adequacy of common shear stress-based equations for modeling erosion and sediment transport in rills. The authors have done well in reviewing the literature. Their study of erosion and sediment transport in naturally formed rills is a departure from much of the previous work in this area and so presents a fresh perspective.

However, the conclusions drawn from this study do not appear warranted. In fact, depending on how the data are analyzed and presented, the opposite conclusions (i.e., shear stress-based equations are adequate for rill erosion modeling) may be drawn (see specific comments below). The authors can do better in substantiating their conclusions based on the data collected and so strengthen the paper.

#### Specific comments

1. The title should be more specific to match the focus of the paper.
2. The abstract is very concise and can perhaps be expanded to include more details of the experiments, the results, and the conclusions.
3. Eq. (3) is dimensionally inconsistent. Please check.
4. P 1250, L 9: "Graf (1971) modified this equation...". Which equation is being referred to? Eqs. (1) to (4) define shear stress, whereas Eq. (5) defines critical shear stress. How are they comparable?
5. P 1252, L 12: "...simplified with time.". Please clarify how the equations are simplified with time.
6. P 1258, L 10: "...in the same dimension.". Please clarify what is meant by dimension here.
7. P 1261: Why use only one transport capacity equation when there are many others in the literature, as highlighted by the authors on P 1254? Likewise for detachment capacity.
8. Please check that Eq. (27) is correct. Is R in the original formulation?
9. P 1262, L 15: Why use RME as a measure of variability? RME suggests that the authors are quantifying random errors in measurements. A coefficient of variation would be more appropriate.

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10. P 1264, L 20: The fact that transport rates exceed transport capacities suggests that  $K_t$  was underestimated. There appears to be a trend in Fig. 4 towards a constant rate:capacity ratio, which supports the use of Eq. (27) with the appropriate  $K_t$ . At low sediment concentrations, the limiting factor may be the rate of sediment detachment rather than the transport capacity. Hence it is not surprising that low sediment concentrations are associated with low rate:capacity ratios.

11. P 1265, L 4: What is meant by "constant dimension"?

12. P 1265, L 4: flow velocity and sediment concentration are input parameters for transport and detachment rates, not capacities. Please clarify.

13. P 1265, L 5: Detachment capacity is proportional to excess shear stress, not just shear stress. Depending on the critical shear stress, a small variation in shear stresses may result in large variations in excess shear stress (and hence detachment capacity). The authors' conclusion here is not justified.

14. P 1266, L 18: Bed shear stress may be partitioned into that acting on bedforms and that effective in erosion and sediment transport. The authors have not addressed this important issue. How similar are the rills in terms of bedform roughness? If, as is often the case, bedform roughnesses are very different, how would this affect the authors' conclusions?

15. P 1267, L 5: The fact that rilling involves a number of different processes does not appear relevant here. The different processes do affect sediment supply, but assuming the sediment supply is non-limiting (probably true for where sediment concentrations are high, Fig. 4), sediment transport rates are limited by transport capacities. As Fig. 4 shows, the rate:capacity ratios are roughly constant where sediment supply is non-limiting. This appears to support the use of shear stress-based equations.

16. P 1269, L 7: The authors have only investigated the suitability of shear stress-based equations for erosion modeling, and it could be argued (see above comments)

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from the results that shear stress-based models are reasonably good. The authors' conclusion here appears unjustified. The authors should also investigate the suitability of stream power-based models.

17. P 1269, L 23: Since shear stress is a function of slope, liquid density and hydraulic radius, small variations in these parameters may mean large variations in shear stress. The authors should also take into account critical shear stresses, another source of variability.

#### Technical corrections

1. P 1249, L 7: "theses" should be "these".
2. P 1249, L 19: "oder" should be "or"?
3. P 1249, L 22: "not-everyday" better termed "less common".
4. P 1250, L 7: gamma is "unit weight" rather than "fluid density".
5. P 1253, L 5: change "to find" to "found".
6. P 1258, L 11: change "what" to "which".
7. P 1259, L 9: change "hardly" to "little".
8. P 1260, L 19: change "what" to "which".
9. P 1261, L 17: "A = flow area"?

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